Preventive Medicine and the Practice of Obstetrics

By A. T. ELDER, M.D., B.HY., D.P.H.

Deputy Chief Medical Officer, Ministry of Health and Local Government, N.I.

As Central Government, Hospital, and Local Government Health Services are now developing simultaneously in Northern Ireland (surely a somewhat unique circumstance), it might be deemed a suitable time for this study of preventive practice in midwifery.

And it might be asked—Can there be a lot to talk about? We have first-class teaching maternity hospitals in Belfast, with an extremely low maternal mortality rate, a comparative immunity from infection in the nurseries of maternity wings throughout the Province, and an overall maternal mortality rate of 1.9 per one thousand live births for 1947.

For the year 1947 the two large maternity hospitals in Northern Ireland—the Royal Maternity and the Jubilee Hospital (dealing largely with complicated cases)—returned maternal mortality rates of 4 per one thousand total births (approx.). During the year 1948 there were only two maternal deaths in the Royal Maternity Hospital, both of which were due to causes associated with pregnancy!

There is a great deal for us to think about, however, in the matter of provision of maternity schemes generally, both in and out of hospital.

For a study of any breadth and consequence one must rather shamelessly invade the territories of the obstetrician, the physician, the bacteriologist, the general practitioner, and the medical officer of health.

THE BACKGROUND OF THE CONTROL OF INFECTIONS.

There is much of interest in an article entitled "The History of the Belfast School of Obstetrics, 1793-1933," by Professor C. H. G. Macafee.[27] Much that is in this paper illustrates the truth of the impression often gained by the student of these matters, namely, that, in common with many another worthy project, the maternity services have developed in the face of oft-recurring opposition and petty obstruction. This is not a fact pertaining to Northern Ireland alone.

The Belfast Lying-in Hospital, the early predecessor of the present imposing building, was one of the oldest maternity hospitals in the British Isles, being the sixteenth to be founded between 1736 and 1799. This original hospital (first proposed in 1793) possessed six beds.

The training of nurses was first accepted only in 1879, and we are told that Professor Burdon, who played a large part in the development of obstetrical practice in Belfast, "during his eighteen years as professor, accomplished much in the face of narrow-minded opposition."

But as a curious anomaly, though many difficulties had been thrown in the way of the obstetricians by the physicians of the times, it was, amongst others, due to

the efforts of Professor Lindsay, "a physician gifted with long vision," that we owe the decision to erect the Royal Maternity Hospital (one hundred beds) opened in 1933 and built at a cost of £114,000.

We are told that, in 1837, the old Lying-in Hospital was ravaged by puerperal sepsis; this in common with the times. The mortality rates were high in hospitals throughout the country, but this is scarcely a true reflection of the maternal mortality rates generally of a century ago.

In the old Edinburgh Maternity Hospital, from 1823 to 1844, out of 3,906 deliveries there were in all 75 deaths, a mortality of 19 per 1,000, mainly due to sepsis. Dr. Douglas Miller considered it probable that, in 1840, the maternal death rate throughout the country was in the neighbourhood of 10 per 1,000 live births.[25]

With the assistance of the Registrar General's Department of Northern Ireland, I have been able to study the maternal mortality rates for Ireland, as a whole, as far back as statistics are recorded in print.

As I said, the mortality rate for Northern Ireland was 1.9 per 1,000 live births for 1947 (equivalent to an estimated rate of about 1.78 per 1,000 total births).

This figure has fallen to its present level since the years 1934-35, when it was in the neighbourhood of six. But previous to that, the rate had remained more or less stationary at between 6 and 7 per 1,000 live births for about sixty years up to 1900, uninfluenced to any material extent by even wars or Lister's discovery of antiseptics!

If wars played any part at all it was to show a slight reduction in the rate (Boer War and Great War (1914-18).

I am indebted to the Registrar-General in Northern Ireland for permission to reproduce the following comparative table and graph, which illustrates the fall during World War No. 2.

MATERNAL MORTALITY RATES IN NORTHERN IRELAND, ENGLAND AND WALES, SCOTLAND AND EIRE, 1922-46.

YEAR	ENGLAND AND WALES	SCOTLAND	EIRE	NORTHERN IRELAND
1922	3.81	6.6	5.7	4.7
1923	3.82	6.4	4.8	4.9
1924	3.90	5.8	4.8	4.5
1925	4.10	6.2	4.7	4.4
1926	4.12	6.4	4.9	5.6
1927	4.11	6.4	4.5	4.8
1928	4.42	7.0	4.9	5.2
1929	4.33	6.9	4.1	4.9
1930	4.40	6.9	4.8	5.3
1931	4.11	5.9	4.3	5.1
1932	4.21	6.3	4.6	5.3
1933	4.51	5.9	4.4	5.4
1934	4.60	6.2	4.7	6.3
1935	4.10	6.3	4.7	5.5
1936	3.80	5.6	4.7	6.1

Year	England and Wales	Scotland	Eire	Northern Ireland
1937	3.51	4.8	3.6	5.0
1938	3.37	4.9	4.1	5.3
1939	3.25	4.5	3.4	3.8
1940	2.78	4.4	3.7	4.2
1941	2.90	4.9	3.2	4.2
1942	2.56	4.2	2.5	3.0
1943	2.36	3.8	2.3	3.2
1944	1.98	2.9	2.4	3.1
1945	1.84	2.8	2.4	2.7
1946	1.47	2.3	2.0	2.3
1947	—	—	—	1.9

See chart of maternal mortality rates in Northern Ireland, England, and Wales on page 133.

In 1864 there were for all Ireland 879 recorded deaths from childbed causes against a figure of 136,414 live births, giving a rate of approximately 6.4 per 1,000 live births.

Between the years 1841 and 1851 there were 8,648 deaths, but against this average of 860 deaths per annum it must be remembered that the population of all Ireland was over eight million in 1841, falling progressively to less than six million in 1861, due mainly to emigration. As the population, and hence the numbers of live births reduced themselves, so did the numbers of maternal deaths reduce, leaving the actual death rate much the same year by year.

Since the number of hospital beds could not be many, compared with modern requirements, the maternal mortality trend reflects the degree of safety of the *domiciliary* practice of midwifery.

From 1936 onwards, with the discoveries of many more drugs of the sulphonamide group, and the subsequent introduction of penicillin, the death rate has come down spectacularly in all parts of the United Kingdom. We should consider (a) whether it is only in that part due to sepsis that improvement has occurred, (b) what other factors are playing an important rôle in the overall reduction in maternal mortality rates.

To assess this, it is necessary, first of all, to study the background of the more recent advances, first in the control of sepsis, and then in the overall advances in obstetrics generally.

Although much has been discovered relating to the nature of puerperal sepsis in the past ten or twelve years, the promotion of theories on the subject goes back a long time. There is always someone who sees the truth, or at least suspects it, long before it is actually proven.

Even as Patrick Manson talked of mosquitoes before Ronald Ross proved their relationship with malarial spread, and even as the Duchess of Cleveland was convinced of the means of preventing smallpox a hundred years before Jenner ventured on his trial vaccination, so we find that over a hundred years ago Pasteur was emphasizing the dangers of the human carrier.

This subject of the means by which infection is spread has engaged the attention

of research workers for the past fifty years. To begin with, there were several parallel lines of attack—one connected with the investigation of spread of infections generally and not necessarily associated with maternity work, a second about twenty to thirty years later connected with the study of infections in maternity hospitals, but lacking the advantages of modern bacteriological methods. About ten years after that the two ideas come together and real progress begins.

For instance, Power, in 1880-81, at the Fulham Hospital, studied the possibilities of aerial transmission of germs (in relation to smallpox), while, in 1897-99, Flugge and his pupils propounded the theory of more intimate contact and spread by droplet infection.[2]

In 1908 Biernacki introduced into the Plaiston Hospital the idea of "barrier nursing" by the use of visible screens, and in 1910 Crookshank, at the Bann Hospital, Mortlake, began a modified system of bed isolation.[2]

And although Kirstein[3] had thought of the possibilities of dust-borne infection in 1902, it was not till 1936 and 1938 that White and Cruikshank respectively studied the subject on a truly scientific basis.[3]

Elizabeth White recorded that in twenty-seven single-bed wards, housing patients discharging hæmolytic streptococci, the air was always contaminated by that organism, and the strain was identical with the strain from the patient.[1]

It was thought unlikely that a healthy throat carrier of hæmolytic streptococci would create a zone of streptococci-carrying particles around him (Colebrook, 1933).[1]

Cruikshank, in 1935, found that the air of wards where patients were being treated for burns frequently yielded strains, and interest in aerial spread of germs was thus re-awakened by the study of dust-borne infection.[2]

Also, in 1935, came Dora Colebrook's monumental work on "The Source of Infection in Puerperal Fever due to Hæmolytic Streptococci."

V. D. Allison linked up the various strains of streptococci, and then, in 1937, Brown and Allison carried out their interesting work of plating out organisms recovered from the air of wards housing patients suffering from scarlet fever.[2]

Finally, Godber and Cruikshank, in 1939, pointed out that the clinical case, the carrier, and the dust of wards must all be followed up for the various strains of prevalent germ and groups and serological types integrated.[2]

Research did not stop during the war years. Indeed, if anything, interest was quickened.

Van Den Ende, Dora Lush, and ff. Edward, writing in the *Lancet* in 1940, pointed out that viable streptococci could be recovered from the air of rooms in which blankets, artificially infected with streptococci, had been beaten and that the application of crude liquid paraffin to floors before sweeping greatly reduced the aerial contamination.[3]

A great deal was written concerning the technique of dealing with floors (Kenny & Barber[4]; Anderson, Buchanan, McPartland[5]; Harwood, Pownsey, Edwards[6]), etc., in 1944.

From 1941 interest developed in the scientific control of infections other than

puerperal, e.g., neonatal deaths (by the occurrence of high mortality rates in infections amongst the babies in the maternity hospital nurseries).

1945 to 1947 saw much study of this subject (Rubenstein & Foley, U.S.A., 1947[10]; Stern, 1947[14]; *Lancet* Leader, 1946[15]; Brown, Crawford, Stent, 1945[16]; Shera, 1947[17], etc.

Before Dora Colebrook's work, however, there had been a good deal of general study of puerperal infections by various public health workers.

For example, one might quote the clear-cut report of Sir Alexander McGregor on Puerperal Infection in Maternity Hospitals in Glasgow (1930),[7] and prior to that the Aberdeen Report on Maternal Mortality covering the years 1918-1927 (Kinloch, Smith and Stephen).[8] Their conclusion is worthy of repetition—"We take the view that the carrier physician, carrier nurse, and the carrier patient can spray streptococci on the sterilized hands, and sterilized instruments . . . (which) . . . in turn infected the maternal passages." A hundred years after Pasteur, we agree with him officially !

The report suggested the use of masks, methods of sterilization of hands, use of gloves, etc., and dealt with the dangers of infected dust and overcrowding.

Bacteriology, obstetric practice, and public health having come together on common grounds of scientific interest, there fall to be mentioned the Ministry of Health Reports of 1937 on Investigations into Maternal Mortality throughout England and Wales.[25]

These reports went much further than discussions of the control of sepsis, and opened up enquiry into maternal mortality in its widest possible sense.

To-day, when mortality rates are falling everywhere, there are so many factors now known to play a part in their reduction that an interest can be provided for all sections of the profession, each having his part to play in greater or less degree, though, as I hope to show presently, it will fall, in the end, to the obstetrician to set the seal on fifty years of intensive effort.

Technical Advances which have influenced the Modern Outlook.

I should like now to discuss the bacteriological aspects of prevention before proceeding to the more clinical and general aspects of administrative maternity schemes.

Bacteriology :

(a) *Laboratory Control of Puerperal Sepsis.*—The knowledge that bacteria could be found fairly easily in suspension on particles of dust from floors, furnishings, and bedclothes, and that dust-borne streptococci could be resistant to ultra-violet light rays and chemical aerosols (Twort, et al., 1940) led to the introducton of methods of reducing the dust in the atmosphere, or potential dust which might easily reach the atmosphere.

An Army experiment carried out in 1944 by Anderson, Buchanan, and McPartland showed, in a controlled experiment extending over three months, that where floors were oiled, the rate of respiratory infections contracted by the sleepers was considerably less than that where no oiling was done.[5] The practical objections to oiling are

apparent, and while Cruikshank stated (1939) that cleansing of polluted air by free ventilation and damp dusting and sweeping were two ways, probably effective, of preventing air-borne infection,[2] at the same time Leonard Colebrook came out strongly in favour of oiling in 1946. He says, "Oiling of floors once in every two to three weeks should become standard practice."[20]

Probably since little oil is required, the fault, if any, lies in too generous application with the production of over-sticky flooring. Objections to the oiling of blankets are dealt with by Colebrook, who suggests dipping blankets and woollen articles in special oil and opening out in a centrifuge. Steam heat at 5 lb. pressure for twenty minutes sterilizes the blankets and does not injure them.

Colebrook describes also the "slit-sampler" devised by Bourdillon, Lidwell, and Thomas for determining the bacterial content of the air. Air is sucked in by electric pump at a definite rate on to a slowly revolving blood-agar plate producing what might be termed a bacteriograph.

As with every discovery, newer and better methods soon come along, and Harwood and others describe a new technique for the application of dust-laying oils using Fixanol C and Teepol (1944).[6]

Much greater speed and accuracy in determining the source and hence applying effective control is possible with the development of knowledge regarding the typing of various strains of organisms.

Whereas early attempts at control were very general so far as the laboratory work was concerned, now great care in the taking of nose and throat swabs and provision for their proper bacteriological examination is required if potentially dangerous carriers are not to be missed.

As examples of this, may I mention just a few instances. Kenny & Barber (1944) describe seven cases showing the same type of organism and where the probable source of infection was traced to an infected lavatory seat.[4]

Dora Colebrook had previously illustrated the value of absorption—agglutinin methods. In one investigation of 837 women examined, two only of the fifty-two strains recovered were human pathogens, giving rise to a severe infection, while in another of forty-six severe cases, forty-five were infected by human pathogens.[9]

Although the next example is rather outside the subject of puerperal infection, it nevertheless is worthy of notice as illustrating the value of modern bacteriological methods. G. C. Williams and Carol Sims-Roberts described an outbreak of pemphigus neonatorum in a private nursing home (1947) due to phage type 3A staphylococcus aureus which was recovered from the bullæ of four cases, the nose and throat of one case, one baby with nasal discharge, one non-affected baby, and Nurse B (a heavy carrier).

Knox and Marmion (1945) described an outbreak of streptococcal infection due to Type 25 recovered by slit-sampler plate from air and dust and ultimately connected up with a sore finger of Sister R. The following statement is illuminating: "If a swab (of the finger) had been examined at that time, and if hæmolytic streptococci had been isolated, the whole outbreak might have been prevented."[22]

If I may seem to have laboured this aspect of prevention, let my excuse be that

I have known of several instances where control was held up by a reluctance on the part of those in charge, sometimes medical, sometimes nursing, to face the fact that the tracking down of such infection to the real source was not a reflection on the hospital, but a matter of great urgency, and that delay produced undesirable publicity instead of obviating it.

The other important lesson is the desirability of readily accessible first-class laboratory facilities.

(b) *Neonatal Morbidity*.—Let us consider for a little the prevention of gastro-enteritis among the newly-born in our maternity homes and hospitals.

The leader article of the *Lancet* (28/12/46) draws attention to two types of gastro-enteritis—(a) a mild type affecting babies and adults of all ages, and (b) a severe type affecting mostly infants under three months. The example given of the former was that at Cowley Road Hospital, Oxford, where twenty-nine babies were affected, with no deaths (60 per cent. of the mothers in hospital were affected also).

The severe type was exemplified by that at the Leicester General Hospital, where in a small outbreak with a high mortality twenty-five babies were affected, and there were twelve deaths.[15]

In regard to the mild type, Brown, Crawford, and Stent (1945) pointed out that an epidemic of diarrhœa and vomiting might run concurrently in people of all ages and sexes in the surrounding district, and was, therefore, a much more widespread problem than for the hospital alone.[16] A questionnaire sent out to general practitioners brought out these facts, but it was clear to me in my visits throughout the country that the widespread nature of this mild type was a fairly common occurrence.

Ormiston, summarizing the pathological findings in three outbreaks in 1941, demonstrated the negative nature of stool cultures in outbreaks with a case fatality rate of 29 per cent., and made mention of the fact that hospitals were unduly reticent when such outbreaks occurred.[11]

Sakula (1948)[12] and Shera (1947)[17] dealt with the morbid processes and stressed the probable virus origin of the disease, the virus probably affecting the gut with toxic manifestation in the liver and brain, and wasting of thymus and suprarenals.

Sakula mentioned that in his outbreak "breast-fed children remained well, while those receiving bottle feeds of whatever kind became ill," and Stern (1947), in dealing with an outbreak at West Middlesex Hospital, stated that "the only common factor was pooled feeding-bottles and teats."

Finally, in America, experiments in subjecting volunteers to inhalations of a mist concocted from the dried fæces of sufferers from gastro-enteritis were successful in producing gastro-enteritis in the volunteers. While this is not a conclusive type of test by any means, the sum total of these observations give a lead to the type of preventive action required.[31]

Now this preventive action is in no way different from action required for almost any type of alimentary infection, and in my own experience of severe outbreaks with as high a mortality rate as 33 per cent., an almost immediate control could be instituted even where one did not know any more than that there was the probability

of a severe virus type of infection. The full co-operation of the hospital authorities was, however, not always given to the field worker with that spontaneity and air of urgency which is so desirable where lives of babies are to be saved by immediate and somewhat drastic action.

This is not a fact that should be glossed over, and certainly no hospital authorities with the necessary breadth of vision would wish to gloss it over.

During a war urgent and drastic action may often require an amendment of accepted routine, and this is a "war" on disease, in which we must all play our part with the fullest co-operation.

Having mentioned the main discoveries and trends, let me now summarize the chief lines of action which have been advocated in control of epidemic disease of mothers and/or babies, but before so doing, may I just say that a routine which will ensure, as far as possible, total prevention of spread of infection is surely to be commended, even though it may interfere to some extent with nursing staff routine and teaching methods. Routine and teaching can be altered without detriment to the pupil's real interests.

Summary of Preventive Methods in Use and Advocated for the Control of Infections.

"The coming of penicillin, and the sulphonamides does not constitute any ground for complacency in the matter of puerperal infection," says Leonard Colebrook.

Practical steps which may be taken on the occurrence of a case are infinitely easier to remember than those less obvious steps which should be instituted as a routine to prevent infection arising. And mainly because the latter may cause a little trouble or effort to be made, for no apparent reason so far as the unthinking mind is concerned.

For instance, Kenny and Barber (1944)[4] give us two useful ideas arising out of their experience.

(a) That students and members of the staff should be "bacteriologically examined" before initial entry to the hospital, and on each return from leave. This would presuppose a ready and efficient laboratory service.

(b) Each patient admitted in labour has a shower-bath, and after being shaved has the vulva and surrounds painted four-hourly with dettol cream (30 per cent.) until delivery.

I need not detail the general measures to be taken on the occurrence of infections, except to say that the Medical Research Council War Memorandum No. 11 on "The Control of Cross Infection in Hospitals" would well repay close study by the profession and students at large.[2]

Cruikshank and Godber (1939)[2] pointed out that—

(a) "Patient contacts may become vaginal or cervical carriers of the epidemic streptococcus, and if not sought out may act as foci for the maintenance and spread of infection.

(b) Just as a streptococcal sore throat may be the source of an outbreak, so

secondary cases of tonsillitis may occur concurrently with infection of the genital tract; and

(c) Great care in the taking of nose and throat swabs and provision for their proper bacteriological examination is required if potentially dangerous carriers are not to be missed."

We read on page 19 of the War Memorandum No. 11 that "Noses, throats, and any discharges, abscesses, infected wounds, etc., of patients should be swabbed and examined for hæmolytic streptococci." The need for segregation of cases and carriers is stressed, and emphasis placed on unhealthy nasal passages or fauces. (Too often is a case with a slight temperature retained in the lying-in ward when removal to isolation is the obvious step to be taken.)

Sources of infection are summarized concisely as follows :—

(a) Respiratory : Nose and throat secretions, ear, mastoid and sinus discharges and sputum.

(b) Gastro-intestinal and urinary : Fæces, vomit, urine.

(c) Cutaneous : Discharges from septic skin lesions; discharges from mucous membranes, e.g., conjunctiva, vagina.

(d) Wounds : Discharges from septic wounds, burns, and abscesses.

Modes of spread in a hospital are by direct contact, by a variety of vectors ("mediate infection"), by droplets, and by dust.

I have already dealt with the dangers of shaken blankets, and the advantages of oiling and damp dusting.

Dealing with the hospital nurseries, the Memorandum stresses the importance of hand washing, but three pieces of advice are heavily underlined.

(a) *Breast-feeding.*—Breast-fed infants are considerably less prone to gastro-intestinal and respiratory infections than bottle-fed infants. Nursing mothers should, therefore, be urged to continue the breast-feeding of their infants in hospital. Every obstacle should be overcome.

(b) *Preparation of bottle-feeds.*—It is strongly recommended that nurses who change infants' napkins (or otherwise deal with excreta, or with septic conditions) should not prepare or give bottle-feeds.

(c) It is essential that all feeding-bottles, teats, and valves should be boiled after each feed.

Rubenstein and Foley (U.S.A., 1947)[10] state that the use of common utensils and materials is to be avoided. Common oil bottles and "sterilizing bowls" were found to become contaminated in time. Pasteurizing or autoclaving after the bottles have been filled is recommended.

Sakula (1948) stresses that—

(a) "Breast-feeding should be insisted upon.

(b) The preparation of bottle-feeds should be the sole responsibility of one person, who should not, at the same time, have any other duties which may bring her into contact with any possibly infected patient."[12]

War Memorandum 11 recommendation at (b) above and Sakula's views can only be met by the adoption of specialized nursing technique. This I have already dealt with in a short note on the value of task nursing (Monthly Bulletin, Ministry of

Health[19]) by which is meant the separation of the various nursing tasks into clearly defined and separate duties performed by different members of a staff which will help to create an efficient barrier to the spread of disease. (Report on Cross-infection in Children's Wards—British Pædiatric Association, 1946.)

I was pleased to learn, on arrival in Northern Ireland in 1947, that this system was already in use at the Belfast Royal Maternity Hospital and the City Hospital. Many teaching hospitals, unfortunately, still resist the introduction of these safety methods on the score that they "interfere with established methods of teaching."

General Factors which have Influenced the Modern Outlook.

We pass now to factors of more general interest. I have dwelt at length on the bacteriological aspects of prevention because of their importance in homes and hospitals.

A.—The Development of Team Work.

During the latter half of the eighteenth and all through the nineteenth century interest in preventive methods was being developed first by the physicians and then obstetricians helped (or hindered as was sometimes hinted by the physicians).

It was not until the twentieth century that the public health worker comes seriously into the picture. Then we have in sequence the combined efforts of public health and laboratory workers as in the Aberdeen Report, the Medical Officer of Health (Glasgow, 1930), bacteriologists and hospital workers (Colebrook, Cruikshank, etc., etc.), and lastly Government field workers and laboratory workers (war years).

Outside the realm of control of infections with the improvements in technique of blood transfusion, and the development of emergency obstetric units ("flying squads") have come closer working arrangements between the obstetrician, the general practitioner, and the medical officer of health.

Finally, the complete team-work can only be produced nowadays by the happiest of arrangements between obstetricians, practitioners, bacteriologists, and medical officers of health, linked when occasion demands with the field worker.

B. Hospital Considerations.

(i) *Bed and Cot Spacing.*—The "Report on an Investigation into Maternal Mortality" (Ministry of Health, 1937) states (page 229) that adequate floor space and fresh air in all lying-in wards is a necessity, plus the limitation of beds in each ward to a small number, and the provision of a large proportion of single-bed wards.

This remains substantially the modern view, upheld during the war years. Some controversy whether floor space should be at 96 sq. ft., 100 sq. ft., or 120 sq. ft. per bed has arisen at times, but in effect it is only when we go below 90-96 sq. ft. that real trouble by way of infection starts. There is thus a lower limit of safety. Hospitals well endowed with four to six bedded wards usually have a comparative freedom from infection because the smaller ward can be closed and disinfected, etc., more readily.

There must be a sufficiency of nursing staff, however, and wherever staff are overworked and rushed in their duties due care in matters of prevention cannot be observed no matter what floor area per bed is allowed.

Dealing with nurseries, Rubenstein and Foley remark that overcrowding in the nurseries is generally found where outbreaks occur. Thirty square feet of floor area per cot should be a minimum, they say, and no more than eight cots per nursery. Night duty was worst of all for provoking spread of infection (i.e., when least staff are on duty).

(ii) *Hospital Construction generally.*—Dealing with factors in hospital construction which have a bearing on prevention, Leonard Colebrook gives as his opinion that[20]

(a) Maternity hospitals should be built in separate blocks.
(b) There should be a more generous provision of single-bedded wards.
(c) All wards should be designed (especially as regards windows and fireplaces) so as to lend themselves readily to sealing for fumigation by formalin or other vapour.
(d) There should be separate quarters for nurses working on clean and septic cases, though they could mix when out of uniform.
(e) Hospital laundries should be equipped for oiling blankets and other woollens, and there should be separate plants for washing bedding from clean and infected wards.
(f) There should be proper ventilation of labour wards, etc., to ensure a dust-free atmosphere.
(g) There should be a 24-hour bacteriological service available in all the larger maternity institutions.

The need for adequate laundry facilities and the dangers of scrubbing infants' napkins out in the wards were pointed out in the Medical Research Council War Memorandum No. 11 (page 15).

(iii) *The Clyster Room.*—My mention of one outbreak of sepsis that possibly could be traced to an infected lavatory seat does not mean that this is by any means either a regular source of infection or one which must engage concentrated attention, but modern trends in the cleaning and sterilization of bedpans are interesting. While describing a modern type of bedpan unit, may I say also that in my experience of wartime emergency maternity homes where only simple chemical disinfection was resorted to, I never knew of any outbreak of sepsis due to infected bedpans, though, of course, I cannot deny that such an eventuality could have arisen.

The Clyster room, a good example of which was seen recently by our Northern Ireland representative at the Southern Hospital, Stockholm, provides accommodation for patients to use bedpan or W.C. to which they may be wheeled in a specially constructed chair with suitable seat opening.

The room can be made a complete unit or may have adjoining a bedpan unit comprising bedpan washer with flushing arrangement, bedpan sterilizer, bedpan hot drying rails, or hot-air cupboard and space for a wheeled bed.

(iv) *The Milk Kitchen.*—Although the need for breast-feeding and the establishment of human milk bureaux are matters of paramount importance, certain provision for the artificially-fed is necessary, and even in the smallest homes or hospitals, the milk kitchen has come to stay as an essential feature.

Colebrook stresses the need for a separate room or kitchen for the preparation of bottle feeds, with adequate refrigerator storage space.

The M.R.C. Memorandum[21] (page 17) advocates for central milk kitchens the following requirements :—

> "It should be reserved solely for the preparation of infant feeds; be situated as far as possible from sluices, water closets, etc.; be fly-proof; contain equipment for rinsing, cleaning, and sterilizing feeding-bottles, have running hot and cold water laid on, and be fitted with hand-basin, covered containers, racks for feeding-bottles, gas or electric cooker, refrigerator, etc. It should be in the regular charge of a sister or staff nurse who will supervize and teach nurses regarding infant feeds. Staff members should wash their hands thoroughly and don gowns and face-masks before starting work. They should be left free from interruption while in the milk kitchen. Unauthorized persons should not be admitted."

A useful idea suggested by the architect of the Northern Ireland Hospitals Authority permits of construction of the kitchen in two separate parts, one for the cleansing of used bottles, etc., and the other for the preparation of feeds, the two portions united only by the autoclave and a serving hatch. (Scatchard.)

(v) *The Premature Baby Unit.*—The development of such specialized units, served in the larger hospitals by their own milk kitchens, is an important addition to the hospital armamentarium. The most famous example is, of course, the Sorrento Unit, Birmingham, but units now exist in the main Belfast hospitals and are doing excellent work.

These units demand specially trained nursing staff, and one well-equipped unit can serve a wide area. At the same time, however, every one of the lesser homes and hospitals should possess some specially heated cubicle provision and equipment for the care of the premature baby, and be linked up with the domiciliary services for immediate urgent admissions.

Though material assets in the shape of specially heated and humidified wards, "cooling off" cubicles, etc., may be provided, the skill of the operator remains a paramount issue as with every other aspect of midwifery practice.

The possibilities of the adequate home nursing of premature babies has been recently discussed by F. J. W. Miller (Newcastle-on-Tyne).[30]

C. General Teaching over the Years.

Although I may seem to have concentrated on the utterances of various writers intimately interested in the prevention of infections, it would be a mistake to suppose that improvements and the prevention of ill-health, infection, and deaths of mothers and babies were not contributed to in large measure by the general trend of improved teaching, and central guidance over the years.

There is sometimes mistaken antagonism between the large teaching centres

and central and local government bodies, but each in their separate ways have been contributing progressively to the store of knowledge.

Viewing these things dispassionately, I find myself unable either to agree completely or to disagree completely with any particular sections of medical opinion. There are faults in all of us, be we obstetricians, practitioners, medical officers of health, or bureaucrats. But there is good in all of us too! It is to the sifting out of the good that is in us and the welding of it together, not omitting entire mention of the little bit that is lacking in us, that these next few pages are devoted.

References are made to illness and deaths associated with childbirth in the writings of the early exponents of public health, Grant and Farr,[25] and in the early days of World War I, Sir Arthur Newsholme produced a National Report for the Local Government Board. This and the National Surveys of 1937 were largely statistical, but were a tremendous step forward in bringing problems to light in the sense of being mass problems rather than individual, or belonging to any one medical school.

The organized activities of central and local government authorities in England date back to the end of the nineteenth century. The Notification of Births Act of 1907, the Maternity and Child Welfare Act of 1918, the Midwives Acts of 1902, 1918, and 1936 may be taken as landmarks, though the building up of local authority services has been a somewhat gradual process from which the interest and help of the obstetricians has not been divorced, and indeed has reached a point of extremely close contact prior to the passing of the National Health Service Act (e.g., Croydon[29] and other County Boroughs).

I venture to suggest that complete integration of all maternity services was on its way whatever legislation had occurred in the meantime.

Now I should like to take you back twenty odd years to Glasgow in the years 1921-28. The maternal mortality rate varied from 6.37 in 1921 to 8.78 in 1928, and as a main contributing factor puerperal sepsis accounted for seventy-nine of the two hundred and eight deaths in 1928 (3.34 per one thousand live births).[13]

Had sepsis been wiped out completely in the intervening years we should still have had a comparatively high rate without some other important reducing factor.

Albuminuria and eclampsia accounted for 1.52 per one thousand live births, hæmorrhage .63, and other accidents of parturition .97. Toxæmia represented by uncontrollable vomiting, albuminuria and eclampsia caused forty-seven deaths.

Turn now through a few years to figures given in the Ministry of Health Report of 1937.

I reproduce below a table which classifies the percentage causation of deaths directly due to childbearing.[25]

Cause of Death	Present Enquiry		Departmental Committee Reports on Maternal Mortality and Morbidity			
			Interim Report, 1930		Field Report, 1932	
	No. of Deaths	Percentage	No. of Deaths	%	No. of Deaths	%
1. Sepsis	219	34.2	616	38.6	1,111	36.3
2. Eclampsia	73	11.4	218	13.6	326	10.6
3. Operative Shock	62	9.7	145	9.0	319	10.4

Cause of Death	No. of Deaths	Percentage	No. of Deaths	%	No. of Deaths	%
4. Antepartum Hæmorrhage	52	8.1	125	7.8	248	8.1
5. Postpartum Hæmorrhage	21	3.3	92	5.7	204	6.7
6. Other Toxæmias	68	10.6	99	6.2	180	5.8
7. Embolism	28	4.4	113	7.0	206	6.8
8. Abortion	104	16.3	168	10.5	410	13.4
9. Extra-uterine Gestation	13	2.0	20	1.2	55	1.8
Totals	640	100.0	1,596	99.6	3,059	99.9

As you will see, one-third of the deaths was accounted for by sepsis, a tenth by eclampsia, about a fifth by shock and hæmorrhage, one-sixth by abortion.

A report issued by the Department of Health for Scotland in 1935 dealt with 2,527 maternal deaths, and concluded that the percentage of avoidable deaths was 58.7, of which 21.6 were due to negligence of the patient, and 37.1 to faulty technique on the part of the attendant.[24]

	Number of Deaths	Percentage
Sepsis	1,727	37.1
Eclampsia	544	11.6
Operative Shock, etc.	464	9.9
Antepartum Hæmorrhage	373	8.0
Postpartum Hæmorrhage	296	6.3
Other Toxæmias, including chorea and mania	279	6.0
Embolism	319	6.8
Abortion	578	12.4
Extra-uterine Gestation	75	1.6

Now, you see still over a third due to sepsis, over a ninth due to eclampsia, approximately a fifth to hæmorrhage and shock, and one-eighth to abortion.

The figures from the last annual report of the Ministry of Health in England for the year ended March, 1947, are as follows :—[28]

	Number of Deaths	Percentage
Sepsis	70	9.1
Hæmorrhage	122	15.9
Toxæmia	188	24.4
Embolism	58	7.5
Other causes directly associated with child-bearing (mainly obstetric shock)	112	14.6
Ectopic Gestation	22	2.9
Abortion (Septic 28)	66	8.6
Associated conditions	131	17.0
	769	100.0

In 588 cases antenatal care was given as follows :—

By Hospital	83
Antenatal Clinic	138
,, + doctor	10
,, + midwife	28
Midwife	99
Doctor and Midwife	38
	588

"Local investigators reported that in 284 of the total of 769 cases there was an accessible avoidable factor, whilst in 308 cases it was stated that no such factor existed. In 177 cases no opinion was expressed.

Avoidable factors were set out as follows :—

Lack or inadequacy of antenatal care	86
,, ,, ,, ,, obstetric facilities	59
,, ,, ,, ,, hospital or specialist treatment	46
Lack of co-operation of patient or her friends	70
Unsatisfactory home conditions	2
Poor general health or malnutrition	18
Risk of pregnancy should not have been taken	3

In only thirty cases were consultants called to patients in their own homes. In eight instances they were called during pregnancy, in nine during labour, and in thirteen during the puerperium.

Thus, in 67 per cent. of the cases specialist obstetric supervision either was lacking or rather might have been lacking, and might have made a difference if readily available. Obstetricians would, of course, say definitely would have made all the difference!"

The maternal mortality statistics for Northern Ireland for 1947, subdivided according to health authority areas, give the following table :—

	Per 1,000 live births
Belfast	1.28
Londonderry City	2.08
Co. Antrim	1.77
Co. Down	3.01
Co. Londonderry	1.11
Co. Armagh	2.30
Co. Tyrone	4.34
Co. Fermanagh	3.18

The Registrar-General for Northern Ireland gives the following sub-classification of all maternal deaths for the Province for 1947 per one thousand live and still births (the latter estimated only).

Cause	No. of Deaths	Rate per 1,000 total births
1. Hæmorrhage of Parturition and Puerperium	19	0.58
2. Infection	9	0.28
3. Toxæmia of Pregnancy	7	0.21
4. Puerperal Toxæmia	5	0.15

Cause	No. of Deaths	Rate per 1,000 total births
5. Cæsarean Operation - - - - -	4	... 0.12
6. Obstetric Shock - - - - -	3	... 0.09
7. Rupture of Uterus - - - - -	3	... 0.09
8. Retained Placenta - - - - -	2	... 0.06
(a) Hæmorrhage (1)		
(b) Shock (1)		
9. Abortion, including infection following abortion -	2	... 0.06
10. Hæmorrhage of Pregnancy - - - -	1	... 0.03
All causes - - - -	55	... 1.67

Infection no longer appears as the major factor. It occurs, but owing to the availability of effective modern remedies it does not cause many deaths. It could be eradicated as a cause altogether.

Abortion has disappeared as a major issue. Is this because the fear and secrecy associated previously with illegitimacy has disappeared, or is it because of the disappearance of the septic factor associated?

Notice, however, that whereas there is now an improvement in all returns and figures over the past ten years, and whereas eclampsias and albuminurias have ceased to be a major worry, hæmorrhage, shock, and accidents (one-third all told) remain as a guide to what is required now.

Can we safely say that modern drugs have played their part, ante-natal services have played their part, improved obstetrics has played its part? But what is still to be done and whose job is it to do it? In analysing this we must keep the foregoing figures in mind all the way.

And this leads one to the reflection that the standards of midwifery practice can no longer be assessed properly by maternal mortality returns, though these are necessary and a help, but a truer reflection, possibly the only true one, is to be had from the gynæcological wards, gynæcological out-patient clinics, and post-natal clinics.

As to maternal mortality returns, it is right that the results of investigations should be published, though not so much in condemnatory fashion as by way of material for careful study. To this end the employment of obstetricians of fairly senior status for the personal and local investigation is a logical and reasonable proposal, and one that would appeal to all branches of the profession. Both public health and hospital authorities should be in possession of, and take part in the assessment, the summarized results.

The Domiciliary Maternity Services.

The position in Northern Ireland differs somewhat from that in England, in that every expectant mother is guaranteed both a midwife and doctor should she so desire, and also any doctor may take part in the service.

Now this development presupposes two things if we are to make it a success. (a) The midwife will, by the nature of things, come to act instead of the maternity nurse since most mothers will want a doctor too. Thus, close harmony between doctor and midwife working as a team must exist, and (b) The general standard

of midwifery of the medical profession as a whole must be maintained at the highest possible level since all may take part, and not just those with special qualifications and experience.

The supply of trained midwives is giving a little difficulty in regard to geographical distribution and domicile at present, but will even itself out, and there will be sufficient numbers to ensure an adequate service.

At present, for lack of numbers in various parts of the country, the nurse-midwife continues to fulfil a variety of duties.

In another article (*Medical Officer,* 6th March, 1948) I have drawn attention to the extending scope of the work of the trained midwife, and on this score, and the score of lessened risk of conveyance of infection, a full-time *ad hoc* midwifery service is to be preferred.

To arrive at a true picture of these factors in a well-balanced scheme, let us consider first the ante-natal clinic, and its value to the community.

The Ministry of Health Report of 1937 stated that "supervision of expectant mothers should be preventive in outlook, and educative, and ought to be instituted at as early a stage as practicable, and regularly maintained throughout pregnancy."

Mention is made of the early interest of the health visitor, and of the midwife too. The duties of the midwife during the ante-natal period are set out in the rules of the Central Midwives Board. Apart from the universally accepted hospital ante-natal clinics and consultative clinics, the report urged that an ante-natal clinic should be established in every district where the number of expectant mothers justified such a provision. "The function of the clinic is twofold, (a) to act as a centre for the routine examination and education of pregnant women, and (b) to sift the abnormal from the normal."

Now to do this the report urged at the time certain advice as to the medical staffing, and the duties of consultants. I should like to quote two passages, for they have a bearing on what we should like to do here in Northern Ireland (and I would ask the reader not to jump to conclusions till he reaches the final suggestions below !)

"(a) The officer in charge should work under the administrative direction of the Medical Officer of Health for the area, and such officer should hold the Diploma of Public Health, and in addition to experience in child welfare, *should have acted for a period of not less than six months as a resident obstetric officer, etc., etc."*

"(b) The duties of a consultant, under the administrative supervision of the M.O.H., should, wherever practicable, include :—

(i) Assistance to general practitioners in domiciliary cases, etc.
(ii) Attendance at consultative ante-natal clinics, etc.
(iii) Clinical charge of the maternity department of the area.
(iv) Clinical charge of the puerperal sepsis unit.
(v) Attendance at post-natal consultative clinics.
(vi) The investigation of circumstances associated with maternal deaths in the area."

Hilda Menzies,[23] writing from the Leyton Public Health Department in the

Medical Officer of 6th November, 1948, after mentioning damning criticism of local authority ante-natal clinics in the report of the Royal College of Obstetricians and Gynæcologists of 1945, proceeds to defend the municipal clinic. She points to the large numbers of women who benefit by advice at these clinics and to the average mortality rate in Leyton being much less than that for England and Wales as a whole.

Her article, as did the many reports before this, simply bears out once more the value of routine ante-natal supervision. My analysis of causes of death down through the years has, I think, pointed in this direction also, but as I have also indicated the maternal mortality rate cannot be accepted as the only foot rule for assessment.

The salient features, I imagine then, are as follows :—

(1) Outside the hospitals there is a need for ante-natal clinics in suitably selected areas for the convenience of the mothers.

(2) Attendance of the health visitor, and the midwife who will subsequently attend the case, is desirable (as in the Croydon scheme). These are health authority employees, and the domiciliary services are vested by law in the health authorities. It follows that the medical officers of health will be interested administratively in the scheme.

(3) The doctor operating the clinic should have resident obstetric experience, and a consultant should attend on occasion.

(4) Routine preventive "screening" of all primiparæ and high grade multiparæ is justifiable because the general practitioners would welcome help from someone specially versed in obstetrics, and this is all the more desirable if all doctors are to join the scheme.

(5) It may be wasteful to have a consultant in attendance for all routine screening, hence the junior grade of obstetrical officer should be employed in this. Such an officer cannot give of his or her best without also a hospital connection, viz., registrar part-time.

I would, therefore, advocate :—

(i) Ante-natal clinics to be set up outside hospitals by health authorities, and equipped by them and staffed by them as far as nursing attendance is required.

(ii) The medical staffing should be allocated by the Hospitals Authority—consultants as required for special sessions, routine to be carried out by junior obstetric officers of the registrar grade, who would also operate the Emergency Obstetric Service (Flying Squad) for the area.

I have not mentioned "gastro-enteritis" teams, the Rh factor, radiology or anæsthesia, not because these things are unimportant, but because they do not bear directly on the administrative action required in the scheme. I may mention in passing that gastro-enteritis is now a notifiable disease throughout Northern Ireland (as from January, 1949).

A word or two may be opportune in regard to forceps deliveries. It has always been drummed into us by those who know best that unhurried midwifery is the safest midwifery, and this fact needs no further emphasis from me. We can achieve

this if doctor and midwife work as a team. The doctor is a busy man, but with a trained midwife acting as his maternity nurse, and especially since such midwives are now trained to use analgesia, a happy working arrangement that will allow of the doctor being called judiciously, may allow of the time factor being given its opportunity as has never been properly done in the past.

A thought should be given to the need for refresher courses of instruction for practitioners taking part in the Domiciliary Midwifery Services.

For the rest, we are always learning!

Conclusions.

I have tried in this all-too-short paper to study the more important trends and developments in the maternity services in and out of hospital, which are of greatest interest to those concerned with the administration of the services, and with the accent on prevention.

Modern developments in the accuracy of bacteriological investigations have been discussed, and three ideas emerge which are of major importance :—

(a) The need for a readily accessible first-class laboratory service in all maternity work.

(b) The need for a 24-hour laboratory service for all major maternity institutions.

(c) The need for team-work of the closest nature between obstetricians, administrators, and laboratory workers.

Certain structural changes in maternity hospital design have been dealt with, and certain essentials in nursing technique and staffing arrangements, with particular reference to gastro-enteritis in nurseries.

The trend of maternal mortality rates has been traced over the past fifty to a hundred years, with particular reference to Ireland.

The desirable administrative features of a good domiciliary midwifery service have been discussed, and with particular reference to the special position of Northern Ireland.

The need for readily available consultant obstetric facilities within the framework of a health authority scheme for domiciliary midwifery has been discussed, and it has been pointed out that the truer reflection of standards of midwifery lies in the study of cases in gynæcological wards and out-patient gynæcological and post-natal clinics rather than in any further study of maternal mortality rates, though such studies are of value.

To finish, may I commend two impressions I have gained from this study. The first is that any enquiries into maternal deaths or consultant advice given out should not sound a condemnatory note, but rather be carried out or given in a sympathetic form for the benefit of subsequent patients, for are we not all striving towards perfection all the time? Secondly, I would commend an intimate assessment of gynæcological conditions seen at hospitals and post-natal and gynæcological clinics by our professors of midwifery and of social and preventive medicine, for the benefit of our future doctors and their trusting patients.

I am indebted to the Chief Medical Officer, Dr. James Boyd; to Professor

C. H. G. Macafee; to Professor J. M. Biggart; and to Mr. John Oliver, for helpful criticism and useful suggestions, and my thanks are due to the Ministry for permission to publish this article.

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REVIEW

VISUAL DEVELOPMENT. (Vol. I). By J. H. Prince, F.R.M.S., F.Z.S., F.B.O.A., F.S.M.C. Edinburgh: E. & S. Livingstone Ltd. Pp. 418. Price 50s.

THE author states that one of the main purposes of his book is to create a desire on the part of young men entering the optical and ophthalmological professions to enter the field of research and field study. Professor H. Hartridge remarks in the foreword that he found the book full of information, much of which is new.

The field termed by the author "Ocular Naturalism" would perhaps be better understood as "Natural History," paying special attention to visual equipment. In this field he has laboured considerably, and he has included in his pages the results of his labours. The fundus appearances of the eyes of a great variety of vertebrates is illustrated in colour, together with photo-micrographs of many retinæ. There are chapters discussing the varying shapes of the pupil in different animals and on the nature and functions of tapeta.

A chapter on "Colour Appreciation in the Lower Orders" leads to a discussion on colour vision in man, in which a survey is made of the different theories and suggestions offered on which a new theory may be based.

In the discussion of night vision the induction of retinitis pigmentosa by exposing nocturnal animals to excesses of daylight is instanced. The author reports an investigation he has carried out in defective night vision which led him to the conclusion that the nicotine ingested by cigarette-smokers has a marked effect on night vision in certain individuals.

Two chapters are devoted to technique, one on securing, staining, and mounting specimens and one on microscopy.

A criticism which might be made is of the way in which the bibliography is set out. The reviewer finds the more usual method of setting out the authors' names in alphabetical order preferable to an alphabetical list of titles of articles. The serious student of comparative anatomy would find the bibliography enriched if it included a reference to Rochon-Duvigneaud; Les Yeux et la Vision des Vertebres; Masson, 1943, with its extensive references to the Continental literature. One also feels that a book on visual development might well refer in its bibliography to Ida C. Mann's classic, "Development of the Human Eye," 1928.

Messrs. E. & S. Livingstone have produced a very attractive volume which reaches or perhaps surpasses pre-war standards of paper, printing, and illustration. Volume II is to follow when more dissection has been carried out. Attempts will then be made to prove points and present new theories. In the meantime, Volume I can be recommended as a thought-provoking book which raises and discusses many varied topics. Professor Hartridge, in his foreword, states that he found it absorbing. Others are likely to do so too.

J. A. C.